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(54) RENFORCEMENT DE LA CROISSANCE DES VEGETAUX POUR LUTTER CONTRE LES CHAMPIGNONS PHYTOPATHOGENES ET/OU NUISIBLES LIES AU SOL

(54) PLANT GROWTH ENHANCEMENT AGAINST PHYTOPATHOGENIC FUNGI AND/OR SOIL BORNE PESTS

(57)

The invention relates to the use of aqueous fatty alcohol preparations and/or fatty acid partial esters with low multi-functional alcohols in admixtures with ecologically compatible surface active agent compounds from the class consisting of O/W-type alkyl(poly) glycosides as a mixture of useful materials having a plant-enhancing and/or plant-healing effect against the attack by phytopathogenic fungi and/or soil borne pests.

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(54) RENFORCEMENT DE LA CROISSANCE DES VEGETAUX POUR LUTTER CONTRE LES CHAMPIGNONS PHYTOPATHOGENES ET/OU NUISIBLES LIES AU SOL

(54) PLANT GROWTH ENHANCEMENT AGAINST PHYTOPATHOGENIC FUNGI AND/OR SOIL BORNE PESTS

(57) L'invention concerne l'utilisation de préparations aqueuses d'alcools gras et/ou d'esters partiels d'acides gras contenant des alcools inférieurs multifonctionnels mélangés à des composés tensioactifs écologiquement compatibles de la classe des alkyl(poly)hétérosides de type aqueux, sous la forme d'une composition de matières premières dont l'action permet de renforcer et/ou d'assainir les végétaux contre l'attaque par des champignons phytopathogènes et/ou des nuisibles liés au sol.

(57) The invention relates to the use of aqueous fatty alcohol preparations and/or fatty acid partial esters with low multi-functional alcohols in admixtures with ecologically compatible surface active agent compounds from the class consisting of O/W-type alkyl(poly)glycosides as a mixture of useful materials having a plant-enhancing and/or plant-healing effect against the attack by phytopathogenic fungi and/or soil borne pests.

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(54) Title: PLANT GROWTH ENHANCEMENT AGAINST PHYTOPATHOGENIC FUNGI AND/OR SOIL BORNE PESTS

(54) Bezeichnung: STÄRKUNG DES PFLANZENWACHSTUMS GEGEN PHYTOPATHOGENE PILZE UND/ODER BODENSTÄNDIGE SCHÄDLINGE

(57) Abstract

The invention relates to the use of aqueous fatty alcohol preparations and/or fatty acid partial esters with low multi–functional alcohols in admixtures with ecologically compatible surface active agent compounds from the class consisting of O/W–type alkyl(poly)glycosides as a mixture of useful materials having a plant–enhancing and/or plant–healing effect against the attack by phytopathogenic fungi and/or soil borne pests.

(57) Zusammenfassung

Erfindungsgegenstand ist die Verwendung wäßriger Zubereitungen von Fettalkoholen und/oder Partialestern von Fettsäuren mit niederen mehrfunktionellen Alkoholen in Abmischung mit ökologisch verträglichen Tensidverbindungen aus der Klasse der Alkyl(poly)glykoside vom O/W–Typ als Wertstoffgemisch mit pflanzenstärkender und/oder pflanzensanierender Wirkung gegen deren Befall durch phytopathogene Pilze und/oder bodenbürtige Schädlinge.

Plant Growth Enhancement Against Phytopathogenic Fungi and/or Soil Pests

Earlier hitherto unpublished German patent application DE 197 01 127.6 describes low-foaming surfactant concentrates for use in promoting plant growth. More particularly, the patent application in question describes low-foaming wetting aids in the form of a highly concentrated, but flowable and pourable aqueous surfactant-based concentrate for intensifying the penetration and spreading of water in and around plant roots during their watering, these wetting aids contain as an ecologically safe surfactant component alkyl (poly)glycoside compounds of the o/w type – hereinafter also referred to as "APG compounds" – and in admixture therewith olefinically unsaturated fatty alcohols and, optionally, partial esters of fatty acids with polyhydric alcohols as foam suppressors/defoamers and, in addition, lower water-soluble alcohols as viscosity regulators.

The technical teaching of the further development disclosed in the following makes use of the principles of the earlier German patent application cited above. Accordingly, the disclosure of this earlier German patent application is hereby specifically included as part of the disclosure of the present invention.

The technical teaching of the earlier patent application cited above is based on the following problem: the seemingly simple measure of watering areas of ground, more particularly areas of ground densely populated by plants, can cause considerable difficulties. One example of this are grassed areas partly subjected to pedestrian and/or vehicular traffic where relatively small or even relatively large areas of the grass can dry out despite regular watering. If attempts are made to water these areas, the water does not penetrate deeply into the soil and, more particularly, does not penetrate into the root zone of the grass. The result of this is that

plants in the areas in question can become undernourished, flat-rooted and unhealthy through overdrying. According to the teaching of the earlier application cited above, the surface-active auxiliaries are said to be APG compounds of the o/w type which are known to be used on a wide scale in totally different fields. APG compounds are surface-active auxiliaries for detergents, especially laundry detergents.

The teaching of the earlier patent application cited above is based on the observation that APG-based aqueous wetting aids are also valuable wetting aids in soil irrigation for stimulating plant growth. However, the following problem remains to be solved in this regard: APG-based nonionic surfactants of the type in question are distinguished by particularly high foaming in aqueous preparations. For use in detergents, this is generally welcomed by the consumer. For the field of application with which the present invention is concerned, however, not only is this undesirable, it can even be a distinct disadvantage. Typical foam-suppressing additives are known in the field of detergents, but are unsuitable for the application with which the present invention is concerned, i.e. promoting healthy plant growth. The technical teaching of the earlier patent application cited above uses selected defoamers or foam suppressors which actually promote rather than impede plant growth in combination with the APG-based surface-active components. The selected defoamers in question are the above-mentioned fatty alcohols and/or partial esters of fatty acids with lower polyhydric alcohols.

Another problem addressed by the teaching of the earlier patent application was to enable the multicomponent mixture in question to be made up in the form of concentrates readily dilutable with water, the adequate "portionability" of the concentrate even at normal temperatures also having to be ensured. The technical solution provided by the teaching according to the earlier patent application lies in the above-cited multicomponent mixture containing the APG compounds of the o/w type

together with selected foam suppressors of the type mentioned in an aqueous concentrate of which the viscosity is controlled through the use of limited amounts of lower water-soluble alcohols.

The further development according to the present invention which is described hereinafter is based on the following additional observation: APG-based wetting aids of the type in question not only promote the penetration of irrigation water into the soil structure and hence, above all, into the plant root zone, the multicomponent aqueous mixture introduced into the soil and/or applied to the above-ground part of the plant also shows an unexpected plant-strengthening and/or plant-rehabilitating effect against infestation of the plants by phytopathogenic fungi and/or towards soil pesticides. The plant-growth-promoting fungus populations from the mycorrhiza region and hence from the region of the soil fungus populations connected with the plant roots are not affected. On the contrary, the multicomponent combination according to the invention produces the metabolism and hence the plant-growth-stimulating effects in the region of the rhizosphere and/or in the mycorrhiza region, as reflected in the initiated promotion of plant growth. This is accompanied above all by strengthening of the healthy plant growth by increased resistance to soil pests, more particularly insects and/or nematodes. However, without any claim to a complete explanation of these effects, an additional factor is that, as useful carbon sources, the foam suppressors based on fatty alcohols and/or partial esters of fatty acids introduced into the soil with the surface-active APG components intervene in the life of the plants - controlled by the various microorganisms – in the their root zone and thus also indirectly promote the strengthening of the plants and hence their resistance to phytopathogenic fungal infestation.

EP 0 230 598 B1 describes the use of alkyl glycoside compounds as agents for controlling harmful organisms in compositions for protecting crops and ornamental plants. Besides the APG components also suitable

for the purposes of the invention, the APG compounds enumerated in this document encompass a very much broader range of APG compounds, more especially corresponding APG ethoxylates. More particularly, the document in question described the use of aqueous preparations of APG compounds against plant infestation by leaf lice, red spiders and powdery mildew. APG-based multicomponent mixtures corresponding to the earlier German patent application cited above and hence of the type with which the present invention is concerned, which use the surface-active APG components in admixture with fatty alcohols and/or fatty acid partial esters, more particularly in soil and hence in the root zone of plants, are not disclosed in EP 0 230 598 B1, nor is there any reference therein to the problem of preventing unwanted foaming or to its technical solution as provided by the teaching of the present invention.

Subject of the invention

Accordingly, the present invention relates to the use of aqueous preparations of

- fatty alcohols and/or partial esters of fatty acids with lower polyhydric alcohols in admixture with
- ecologically safe surfactant compounds from the class of alkyl (poly)glycosides of the o/w type (APG compounds)

as a plant-strengthening and/or plant-rehabilitating mixture (multicomponent mixture) effective against infestation of plants by phytopathogenic fungi and/or soil pesticides.

According to the teaching of the invention, multicomponent mixtures of the type defined here are used in particular in commercial plant production, in landscaping and in commercial or domestic horticulture.

Particulars of the teaching according to the invention

Details of the individual components of the multicomponent mixture used, as defined in accordance with the invention, are given in the following.

APG compounds of the o/w type

Reference is first made to the extensive scientific knowledge and literature on the production and properties of APG compounds, more particularly APG compounds of the type with which the present invention is concerned, cf. for example the book by Hill et al. entitled **"Alkyl Polyglycosides", VCH-Verlagsgesellschaft mbH, Weinheim 1997.** The disclosure of **EP 0 230 598 B1** also provides detailed information on the production and properties of APG compounds.

APG compounds preferred for the purposes of the present invention are characterized in that alkyl (oligo)glucoside compounds of which the alkyl group is derived at least predominantly from straight-chain fatty alcohols are at least partly and, more particularly, at least predominantly used. Compounds of this type are surface-active auxiliaries used for a wide range of applications. A number of factors are of importance to their use on an industrial scale. It is known that APG-based wetting agents can be based entirely on natural materials. They are obtained as products of the reaction of fatty alcohols with mono-, oligo- and/or polysaccharides. Where polysaccharides and/or higher oligosaccharides are used with the fatty alcohols, depolymerization is first initiated by hydrolysis and/or alcoholysis in the course of the acid-catalyzed reaction before the required APG compounds are formed. Preferred saccharide components for the formation of APG compounds are glucose and corresponding oligo- and polyglucoses. However, other suitable reactants are saccharide compounds based on mannose, galactose, arabinose and other comparable mono-, oligo- and/or polyglycosides.

APG compounds of the type suitable for the purposes of the invention are obtained as reaction products with the general formula $R-O-(G)_x$, where R is a primary, preferably straight-chain aliphatic hydrocarbon radical containing at least 6 carbon atoms, preferably 8 to 24 carbon atoms and more preferably 8 to 18 carbon atoms and G is a glycose unit containing 5 or 6 carbon atoms, preferably glucose. In the class of surfactants with which the invention is concerned, the degree of oligomerization x and hence the so-called DP value, which indicates the distribution of monoglycosides and oligoglycosides, is normally a number of 1 to 10, for example a number of about 1.2 to 5, preferably a number of about 1.2 to 4 and more preferably a number of 1.2 to 2.

APG compounds of the o/w type, i.e. surface-active components of the type mentioned which are capable of forming oil-in-water emulsions – are known to be distinguished by comparatively high HLB values, i.e. by HLB values above 7 and, preferably, above 8 or 9, particular significance being attributed to HLB values in the range from 10 to 18.

The fatty alcohols used in accordance with the invention

As mentioned above, multifunctional significance attaches to these components of the multicomponent mixtures used in accordance with the invention. On the one hand, they are valuable as foam suppressors in the practical application of the multicomponent mixtures in water-diluted preparations, on the other hand they act as a carbon source for microorganism growth and, more particularly, for promoting the growth of organotrophic microorganisms when used in the soil and, more particularly, in the vicinity of plant roots. Fatty alcohols are both aerobically and anaerobically degradable by natural processes. As a carbon source crucial to organotrophic growth in accordance with the invention, they show lipophilic hydrocarbon radicals of fatty structure in their molecular structure and, hence, a comparatively high concentration of the energy-giving C-H

groups.

According to the invention, preferred fatty alcohols in the multicomponent mixture are distinguished by at least 6 to 8 carbon atoms in the molecule, monoolefinically and/or polyolefinically unsaturated fatty alcohols containing 10 to 28 carbon atoms and, more particularly, corresponding fatty alcohols containing 12 to 24 carbon atoms being particularly preferred. Another preferred parameter for the choice of suitable fatty alcohols lies in the solidification ranges of these components of the multicomponent mixture. Corresponding components with solidification ranges of 20°C or lower and, more particularly, 10 to 15°C or lower are preferred.

Although it is preferred in accordance with the invention to use fatty alcohols based on natural materials of the type under discussion here, the teaching according to the invention is not confined to such fatty alcohols. Fatty alcohols of synthetic origin, which may even have branched chains, are also suitable mixture components in the context of the teaching according to the invention. In particular, the assignment of the solidification ranges of these alcohol component(s) can be influenced in this way.

Fatty acid partial esters suitable for the purposes of the invention

In addition to and/or instead of the fatty alcohols defined above, fatty acid partial esters of – in particular – lower monohydric alcohols can also be important mixture components in the context of the teaching according to the invention. On the lower polyhydric alcohol side in particular, corresponding compounds containing 2 to 6 carbon atoms and, more particularly, 3 to 5 carbon atoms are suitable. Particular significance attaches in this regard to corresponding glycerol partial esters simply by virtue of their ready accessibility as a natural material. The fatty acids of the class of partial esters in question are normally assigned to corresponding compounds containing 10 to 24 carbon atoms,

corresponding C_{12-20} monocarboxylic acids being particularly suitable. It is known that fatty acids of the type in question here are commercially obtainable on a large scale as starting materials from natural sources. In this case, too, it can be of particular advantage to use monoolefinically and/or polyolefinically unsaturated fatty acids. A particularly suitable class of the active substances in question are partial esters of glycerol with olefinically unsaturated $C_{16/18}$ monocarboxylic acids, particular significance again attaching to corresponding monoesters. A fatty acid ester of this type technologically available on a wide scale is glycerol monooleate.

In the same way as the fatty alcohols described above, fatty acid esters with the constitution described here are both aerobically and anaerobically degradable in the soil by natural processes. They are also crucial carbon sources for the organotrophic growth of microorganisms in the immediate vicinity of plant roots. Their use also indirectly strengthens plant growth by stimulating soil microorganism growth.

Further particulars of the teaching according to the invention

According to the invention, it is possible to use either only fatty alcohols or only fatty acid partial esters as mixture components together with the APG compounds. However, one embodiment is characterized by the use of combinations of fatty alcohols and fatty acid partial esters. Preferred mixing ratios – based on parts by weight of the water-free components – are in the range from about 1:1 to 1:10. The fatty alcohols and fatty acid partial esters are preferably mixed in ratios (parts by weight of the water-free components) of 1:1 to 1:5 and more preferably in ratios of 1:1 to 1:3.

In the multicomponent mixture used in accordance with the invention, the APG components are used in at least substantially equal quantities by weight, based on fatty alcohols and/or partial esters, mixing ratios of APG to fatty alcohol and/or partial ester of 1:1 to 5:1, preferably

1:1 to 3:1 and, more preferably 1.5 to 2.5:1 being preferred. These figures represent parts by weight of the mixture, based on water-free mixture component(s).

However, the teaching according to the invention is not confined to the use of APG components in excess. Mixtures with a corresponding excess of the fatty alcohols and/or fatty acid partial esters used as foam suppressors also fall within the scope of the teaching according to the invention.

According to earlier German patent application 197 01 127.6 cited above, multicomponent mixtures of the type with which the invention is concerned are normally marketed and supplied to the consumer in the form of flowable aqueous concentrates. The user then dilutes the concentrate as required with more water for applying the multicomponent mixture to the soil and to the plants. To enable the multicomponent mixture to be made up in the form of concentrates readily dilutable with water, its adequate "portionability" even at normal temperature has to be guaranteed. The teaching of the earlier application cited above makes it clear that, when aqueous APG concentrates are mixed with the above-mentioned foam suppressors/defoamers based on fatty alcohol and/or partial ester, thickened gels, i.e. gels which no longer flow freely, are readily formed. Accordingly, it is proposed in that earlier application to guarantee flowability and pourability, even at room temperature, by adding limited quantities of lower monohydric alcohols and, more particularly, by adding limited quantities of ethanol. The same applies to these mixtures in the context of their use in accordance with the invention. Preferred lower monohydric alcohols are corresponding compounds containing up to 4 carbon atoms.

In one important embodiment, the teaching according to the invention is characterized in that lower monohydric alcohols and, more particularly, lower polyhydric alcohols flowable at room temperature are used as mixture components in addition to the above-mentioned

components of the multicomponent mixture. Multifunctional significance thus also attaches to these polyhydric alcohols in the context of the multicomponent mixture. As liquid mixture components with comparatively high boiling points, they promote the flowability required in particular for handling the concentrate and hence the portionability of the concentrate; on the other hand, these components – after introduction into the soil – act as a nutrient in the form of an additional carbon source for microorganism growth, above all in the rhizosphere and/or the micorrhiza region. Preferred polyhydric alcohols are corresponding compounds containing 2 to 6 carbon atoms and preferably 2 to 4 carbon atoms, particular significance attaching to glycerol and/or glycol. The high solubility in water of the components in question here can also be useful in the practical application of the multicomponent mixtures. Preferred quantities for the mixture components under discussion here are normally at most 30 to 35% by weight, preferably at most 20 to 25% by weight and, more preferably, in the range from 5 to 15% by weight (percentages by weight based on the multicomponent mixture in the form of the above-mentioned concentrate which is subsequently diluted with water for application to the areas of soil to be treated).

In addition to or instead of the unsaturated fatty alcohols described above as a component of the mixture, olefinically unsaturated terpene alcohols are also suitable as foam suppressors/defoamers. Terpene alcohols are acyclic or monocyclic, bicyclic or tricyclic, polyolefinically unsaturated alcohols of vegetable origin which contain between 10 and 40 carbon atoms. The terpene alcohols are preferably used in the form of their naturally occurring mixtures as foam suppressors/defoamers. A particularly preferred representative is pine oil which is a mixture of various terpineols, such as ∀-and ∃-terpineol, ∀-fenchyl alcohol, borneol and isoborneol, as described in Römpp's **Chemielexikon, page 3451, Vol. 4, 9th Edition 1991**. Pine oil additionally contains small quantities of other

non-alcohol compounds, for example camphor, anethol and estragol. Pine oil is obtained from resin-containing stubs and the root wood of various pine species by extraction with, for example, white spirit or chloroform and subsequent fractionation and distillation.

As mentioned above, the defoamer components are normally present in smaller quantities than the APG component, based on active substance. Mixtures in which the defoamer components may be used in distinctly smaller quantities are preferred. Thus, multicomponent concentrates with a defoamer content of about 10 to 25% by weight and preferably of about 15 to 20% by weight are suitable for the purposes of the invention.

The lower water-soluble monohydric alcohols used as viscosity regulators are determined in regard to type and quantity by the principal components mentioned above, by the lower water-soluble polyhydric alcohols optionally used and by the total amount of water present in the multicomponent mixture. Additions of the viscosity regulator of at least about 5 to 7% by weight as a lower limit and 12 to 25% by weight as an upper limit are particularly suitable. Additions of ethanol of about 5 to 20% by weight and, more particularly, 10 to 15% by weight generally have a sufficient influence on viscosity in the direction of the desired flowability and pourability of the multicomponent mixture, even at room temperature.

Finally, another embodiment of the invention is characterized in that selected active components or mixtures thereof from the field of fertilizers containing phosphorus and/or nitrogen are introduced into the substrate to be treated and/or onto the above-ground part of the plant, more particularly onto the leaves. Components which are carriers of these two elements can be preferred representatives of this class of compounds. If desired, other carriers containing macro- and/or micronutrients for plant growth may be used in this connection.

In one particularly important embodiment of the invention, oil-soluble

compounds of P and/or N are used as a component at least partly containing lipophilic residues. Particularly preferred representatives of these auxiliaries are thus the phospholipids described in DE 44 37 313 cited at the beginning and/or derivatives thereof as key representatives of these components.

Preferred components of this class (d) are esters of phosphoric acid with monohydric and/or polyhydric alcohols which contain lipophilic residues in their molecular structure. Among these, corresponding partial esters of phosphoric acid are particularly suitable, generally being used in the form of their (partial) salts.

Accordingly, suitable phosphoric acid esters are partial esters of fatty alcohols which introduce the required lipophilic component into the phosphoric acid ester molecule through the hydrocarbon radical of the fatty alcohol. Partial esters of phosphoric acid with straight-chain fatty alcohols, which have preferably been at least substantially produced using C_{6-10} fatty alcohols and/or lower ethoxylates thereof, are particularly suitable. Basically, however, phosphoric acid esters of higher fatty alcohols, for example containing 12 to 24 carbon atoms, are also suitable, particular significance attaching in this regard to correspondingly olefinically unsaturated fatty alcohol radicals.

However, particularly preferred phosphoric acid esters of the subclass in question are phospholipids and phospholipid derivatives. These are amphiphilic substances which are obtained from vegetable or animal cells. According to the invention, preferred phospholipids are corresponding compounds of vegetable origin and phospholipid derivatives obtained therefrom. Particularly preferred representatives of class (a) are the glycerophospholipids which, normally, are also referred to as lecithin. The sphingophospholipids are less preferred. Known and suitable substances are the diacyl phospholipids, phosphatidyl cholines, phosphatidyl ethanolamines, phosphatidyl inositols, phosphatidyl serines,

phosphatidyl glycerols, phosphatidyl glycerophosphates, diphosphatidyl glycerol, N-acyl phosphatidyl ethanolamine and phosphatidinic acid. The monoacyl phospholipids, lysophosphatidyl cholines, lysophosphatidyl ethanolamines, lysophosphatidyl inositols, lysophosphatidyl serines, lysophosphatidyl glycerols, lysophosphatidyl glycerophosphates, lysodiphosphatidyl glycerols, lyso-n-acylphosphatidyl ethanolamines and lysophosphatidinic acid. The phosphatidyl glycerides marketed as vegetable or animal lecithins and cephalins are obtainable on an industrial scale and available in large quantities. These preparations are obtained, for example, from oils, such as corn oil or cottonseed oil or soybean oil.

Other preferred components are lecithin, lecithin hydrolyzates and/or chemically modified lecithins. These compounds may also be used in admixture with other N-containing components although these additional N components are preferably not used where the multicomponent mixture is applied to the above-ground part of the plant, more particularly to the leaves.

The water content of the multicomponent concentrates is generally at most about 50% by weight and, in preferred embodiments, assumes lower values. Thus, maximum values of about 30 to 45% by weight are particularly suitable for the water content of the multicomponent mixture. In general, the water content of the multicomponent mixture will be far lower than this, for example in the range from 10 to 20% by weight and preferably in the range from 10 to 15% by weight.

In practice, the multicomponent mixtures are applied to the soils and/or plants to be treated in water-diluted form in quantities – based on water-free mixture - of at least about 0.5 g/m² and preferably in quantities of at least 1 g/m². Applied quantities of 0.5 to 35 g/m² are suitable, applied quantities of 1 to 20 g/m² being particularly suitable (applied quantities based on the water-free multicomponent mixture of – in particular – APG compounds, fatty alcohols and/or fatty acid partial esters). A preferred

upper limit to the applied quantities is in the range from 10 to 15 g/m².

In practice, the concentrates described above are diluted with more water and are then finely sprayed preferably in the form of aqueous emulsions/dispersions. It can be of advantage in this connection to use water-diluted mixtures in which the ratio by weight of the multicomponent mixture to water is at least 1:10 and preferably at least 1:15 to 20.

On a practical level, the teaching according to the invention affords hitherto unknown possibilities for strengthening plants on the one hand against infestation by unwanted phytopathogenic fungus populations and, on the other hand, against infestation by soil pests, such as unwanted insects and, in particular, nematodes. In contrast to the hitherto conventional control of these pests by selected synthetic agents which often bear no relation to molecules based on natural materials, the present invention uses active-substance mixtures of which the molecular structure is based exclusively or at least predominantly on natural materials. The desired action mechanism in this regard is, in particular, the indirect strengthening of plants by influencing and building up the plants' own resistance potential, more particularly by correspondingly influencing the metabolism processes in the root zone and hence the life processes of the microorganism populations in the soil which are linked to the life processes in the plant.

The teaching according to the invention also encompasses the important feature described in the following and its effects on a practical level in stimulating soil microorganism growth: the introduction of the multicomponent mixtures according to the invention into the soil leads to a measurable increase in the water-soluble components of phosphorus compounds and thus to an increase in the amounts of phosphate available for plant growth. The strengthening and growth increase of the soil microorganism flora clearly also results in the reinforcement of the aspect in question here in the plant root zone. This secondary effect of increasing

root growth is very clearly in evidence, for example, in grassed areas with an uneven growth density. It is known that the supply of root-available phosphorus to the affected areas results in a more horizontal spreading of the grass roots and hence in expansion of the root zone, more particularly into grass-free areas of soil, so that these originally ungrassed or inadequately grassed areas then develop a covering of grass or secondary covering. These effects are initiated by using the multicomponent combinations according to the invention. More particularly, the spreading of root growth can quickly be shown to be the primary result of plant strengthening. In this connection, determination of the soluble phosphate in the affected area of soil shows the already described increase in this phosphate component. This is another initial effect - hitherto unknown in this form - instrumental in achieving the objective of the invention, i.e. plant strengthening and/or plant rehabilitation.

The following Examples describe selected embodiments of the teaching according to the invention.

Examples

Example 1

Comparative studies in which the development and promotion of the growth of salad plants in window boxes filled with standard soil are determined under identical working conditions and the results obtained are reported in the following Examples. More particularly, the dependence of plant growth under standard conditions on the presence and particular concentration of the multicomponent mixtures according to the invention based on fatty alcohols and/or partial esters of fatty acids in admixture with APG compounds of the o/w type is determined. The effects of using various quantities of conventional plasticizers are additionally determined in comparable tests.

Aqueous preparations of the product marketed by Henkel KGaA

under the name of Magic Wet® in various standard concentrations are used as the multicomponent mixtures according to the invention - APG compounds of the o/w type in admixture with fatty alcohols and/or fatty acid partial esters. Where conventional fertilizer is additionally used in the comparison tests, the liquid fertilizer marketed as Substral® which is characterized by a ratio of N to P_2O_5 to K_2O of 6:2:4 is used. Particulars of the particular concentrations of active substances and auxiliaries used are given in the following Examples.

Materials and methods of the comparative growth tests

6.7 litre window boxes with a surface area of 0.06 m^2 were used as the test containers. Lamb's lettuce seeds were sown in the window boxes filled with standard soil and cultivated for 8 weeks until ready for picking. During this period, the window boxes were watered with the particular test solution at regular intervals (1x before sowing, 9x after sowing) and with water only on four other occasions.

Four different degrees of dilution of Magic Wet as indicated in the following Table were used in the test solutions. Within the individual dilute Magic Wet solutions, three different fertilizing levels were tested:

a) unfertilized (variants 3,6,9,12,15)
b) 15 g Substral long-term fertilizer per box (variants 2,5,8,11,14)
c) 30 g Substral long-term fertilizer per box (variants 1,4,7,10,13)

The various tests (variants) mentioned produced the results set out in Table 1 for the use of the water-diluted Magic Wet solutions.

Table 1

Variants	Product	Dilution	Total quantity per window box (0.06 m²) over test period
1,2,3	Magic Wet	1.0%	27.5 g
4,5,6	Magic Wet	0.5%	13.75 g
7,8,9	Magic Wet	0.25%	6.88 g
10,11,12	Magic Wet	0.125%	3.44 g
13,14,15	Water	-	-

A first test was carried out in December (test I) and repeated in February (test II) with the following proviso: the highest concentrations of Magic Wet in the pouring water in variants 1,2 and 3 are so high that no information of any practical relevance can be gained. Accordingly, the growth tests using this highest concentration were not continued.

The following generally valid observation was made in the course of the tests:

In test I in particular, the plants which had not been treated with Magic Wet showed a very high failure rate which may possibly be attributable to overwatering. Soft rot was observed in the corresponding plants of variants 13, 14 and 15, i.e. the plants which had not been treated with Magic Wet were affected by corresponding soft rot fungi. By contrast, fungal infestation was prevented in variants 4 to 12 through the addition of the lower Magic Wet concentrations for otherwise identical watering and growth conditions.

The following observations apply to the plant yield of the tests used in test 1:

In all the tests, 5 separate but identically treated window boxes were assigned to the particular variant (n = 5). The highest fertilizing level (30 g Substral per box) always produced comparatively lower biomasses (= yield) in test 1 than the unfertilized variants and those fertilized with 15 g of Substral. Average biomasses are shown in Table 2 below

Table 2

Variant	Magic Wet dilution	n	Fertilizer	Biomass
5	0.5%	5	15 g	42.4 g
6	0.5%	5	-	35.8 g
8	0.25%	5	15 g	43.5 g
9	0.25%	5	-	43.9 g
11	0.125%	5	15 g	41.5 g
12	0.125%	5	-	42.6 g
14	0	4	15 g	31.0 g
15	0	5	-	33.3 g

Variants 14 and 15 which had not been treated with Magic Wet produced an average biomass of 31 to 33 g. By comparison, the variants treated with Magic Wet (more particularly 5, 8, 9, 11, 12) produced a biomass higher by about 10 g. At the same time, there were no significant differences between the Magic Wet concentration stages 0.5%, 0.25% and 0.125%.

In test II also, treatment with 0.5%, 0.25% and 0.125% dilute solutions of Magic Wet (% = percent by weight) produced higher

biomasses than the untreated controls. Table 3 below sets out informative data from test series II. Substral was again used as "fertilizer" in quantities of 30 g and 15 g or was not used at all. In all comparable test series, the biomasses obtainable using Magic Wet are clearly higher compared with the parallel tests where Magic Wet was not used. This is particularly clear in the case of the largest quantity of Substral fertilizer used (30 g). This basically excessive quantity of fertilizer is obviously made more tolerable to the plants through the use of Magic Wet; the expected salt damage is buffered.

Table 3 below contains particularly interesting additional information.

In tests 13' and 14', the Magic Wet with its multicomponent mixture was replaced by a comparable quantity of pure APG compound of the o/w type. In other words, the additional carbon sources used in the Magic Wet for bacterial growth were dispensed with. Comparison of the biomass yields obtained in tests 13' and 14' with the comparable variants of tests 8' and 9' shows the clear reduction in the biomass yield. In fact, the yields obtained in tests 13' and 14' are still below the biomass yield of test 10', i.e. the comparison test which uses the same quantity of Substral fertilizer but not addition of Magic Wet. It can clearly be seen that the plant strengthening and stimulating effect of Magic wet is attributable not just to the APG component but rather to the mixture as a whole.

Table 3

Variant	Magic Wet dilution	n	Fertilizer	Biomass
3'	0.25	5	30 g	15.8 g
4'	0.125	5	30 g	8.7 g
5'	0	5	30 g	5.7 g
16	0.5	5	-	36.8 g
17	0.25	5	-	41.5 g
19	0	5	-	35.6 g
8'	0.25	5	15 g	37.4 g
9'	0.125	5	15 g	39.0 g
10'	0	5	15 g	28.1 g
13'	0.114% APG (= 0.25% MW)	5	15 g	26.4 g
14'	0.057% APG (= 0.125%)	5	15 g	19.6 g

Example 2.1

A standard grass mixture for golf greens (DSV 414 with 80% *Festuca rubra* and 20% *Agrostis stolonifera*; 20 g/m^2) was sown in 144 cm^2 trays filled with a standard grass substrate layer of 20% top soil and 80% sand (0.2 mm). During the 8 week cultivation period in a greenhouse, the grass was fertilized with a liquid fertilizer five times and cut three times (including determination of fresh and dry weight). The treatment with the mixture according to the invention marketed by applicants under the trade name of "Magic Wet" was carried out three times over this 8 week period (5th, 7th, 8th week) in two concentrations, always after cutting and together

with application of the liquid fertilizer (0.5% NPK 12-4-6 solution). After the 8 week cultivation period, the grass was transferred to a conditioning chamber (10°C, lighting 14/10). After one day acclimatization, the grass was inoculated by pouring on a dilute mixture of three isolates of *Microdochium nivale* which is responsible for snow mold. Thereafter the grass – covered with filter paper – was left in the conditioning chamber for 8 days under a plastic film. Evaluation was then carried out by visual assessment of the infestation with snow mold. To this end, the quantity of visible fungal mycelium was estimated as a percentage area per tray.

The following variants of the above treatment were carried out in all 10 times:

Variant	**Concentration**	**Total concentration over the test period**
Control = water	-	-
Magic Wet	1 g/m²	3 g/m²
Magic Wet	2 g/m²	6 g/m²

In the case of the control variants, the average infestation of the grass with snow mold mycelium was 78%. This figure was reduced by more than half in the trays treated with Magic Wet (cf. Table 1). Besides this health-sustaining effect of the mixture according to the invention, there were also signs of growth promotion which, in the 2 g/m² variant for example, was reflected in a 21% higher fresh weight of the grass.

Variant	Mold infestation	Average fresh weight (g/tray)	Average dry weight (g/tray)
Control = water	78%	0.80	0.19
Magic Wet 1 g/m²	35%	0.91	0.20
Magic Wet 2 g/m²	36%	0.97	0.21

The mixture according to the invention is suitable for protecting golf greens against excessive fungal infestation in preventive use.

Example 2.2

A standard grass mixture for golf greens (DSV 414; 20 g/m²) was sown in 144 cm² trays which had been filled with a standard grass substrate layer of 20% top soil and 80% sand (0.2 mm). During the 7-week cultivation period in a greenhouse, the grass was fertilized five times using a liquid fertilizer and cut three times (incl. determination of fresh and dry weight). After cultivation for 8 weeks, the trays were inoculated with the snow mold mixture. 10 Days after inoculation, the grass was subjected to the various spray treatments. The effect of the various treatments was evaluated 14 days after application by visual assessment. To this end, the quantity of visible fungal mycelium was estimated as a percentage area per tray.

The following treatments were carried out 10 times in all:

Quantity of Derosal applied	Magic Wet
100% = 18 mg/m²	-
75%	-
50%	-
75%	2 g/m²
50%	2 g/m²
Control = Water	-

As expected, the smallest amount of mycelium was achieved after treatment with a standard dose of fungicide. However, even the fungicide was unable completely to inhibit infestation (25% of the tray area affected) (Table 4). Reduced amounts of the fungicide resulted in greater infestation. The addition of 2 g/m² of "Magic Wet" produced an

improvement in the effect of the fungicide. For example, with 75% of the usual fungicide dose alone, the mold infestation was 40% whereas, where Magic Wet was used with the fungicide, it was only 35%. The presence of Magic Wet also had a beneficial effect on the biomass.

Table 4

Variant	Mold infestation	Average fresh weight (g/tray)	Average dry weight (g/tray)
Control = water	80%	4.0	0.82
100% fungicide	25%	4.1	0.87
75% fungicide	40%	4.1	0.86
75% fungicide + Magic Wet 2 g/m²	35%	4.3	0.88
50% fungicide	50%	4.1	0.85
50% fungicide + Magic Wet 2 g/m²	45%	4.2	0.88

Since the mixture according to the invention supports the curative effect of fungicides (Derosal in the Example), as shown in the preceding Example, it may be used in particular in those cases where resistance can be expected to be built up, as for example with *Drechslera, Pythium* or *Microdochium* species. Accordingly, the mixture according to the invention broadens the range of application of conventional fungicides.

Above all, the quantity in which conventional fungicides are used can be reduced by the mixture according to the invention so that the very serious effects which fungicides are known to have on water, soil and the inhabited environment can be limited. The claimed reduction in the quantities in which conventional fungicides are used can also be equated with an increase in the time interval between two applications. This reduces the danger of harmful fungi building up any further resistance.

The mixture according to the invention differs from conventional fungicides both in its rapid and complete biodegradability and in a totally different action mechanism. Whereas conventional fungicides act directly on the metabolism of the fungus, the mixture according to the invention produces a change in the surrounding environment which is not yet understood in detail. Accordingly, the protection of cultivated plants against fungi and soil pests through the claimed combined use of a conventional fungicide and the mixture according to the invention is based on two different but complementary principles.

Example 3

Grass pathogens isolated in the laboratory and purified were inoculated onto four agar test plates and their mycelium growth was determined after incubation for 5 days at room temperature. Nutrient media of PDA were used. After autoclaving, the mixture according to the invention or rather the individual components were added in various concentrations after sterile filtration. Agar plates with no active substance (i.e. only PDA medium) were used as controls. Since resistant pathogens can occur in the meantime through the use of many fungicides over many years, plates with the conventional fungicides Derosal and Folicur in concentrations of 10 ppm and 100 ppm were included in the study.

Component 1 =	Glucopon 215	45.4% by weight
Component 2 =	HD-Ocenol 80/85	4.9% by weight
Component 3 =	Edenor GMO	14.6% by weight

Results:

Pathogen: *Pythium ultimum*

The mixture according to the invention is suitable for suppressing the fungus responsible for root rot (*Pythium ultimum*) during growth (Table

5). The effect emanates from the mixture as a whole because all three components tested are involved in the inhibiting effect. The fungicide Derosal* is ineffective against the fungus while Folicur is limited in its effectiveness.

Table 5

Pythium ultimum Variant	Average radial mycelium growth (mm)	Reduction in relation to the control
Control = water	54.5	-
Derosal 10 ppm*	54.3	-
Derosal 100 ppm*	51.7	5%
Folicur 10 ppm	42.3	22%
Folicur 100 ppm	0.0	100%
Magic Wet 150 ppm	31.0	43%
Component 1 100 ppm	35	35%
Component 2 100 ppm	54	-
Component 2 5000 ppm	31	43%
Component 3 100 ppm	54	-
Component 3 5000 ppm	35	35%

Pathogen: *Microdochium nivale*

The mixture according to the invention is suitable for suppressing the fungus responsible for snow mold (*Microdochium nivale*) during growth (cf. Table 6: for example Magic Wet 150 ppm = 2 g/m²: suppression of the isolate "Nor77" by 50%). The effect emanates from the mixture as a whole because all three components tested are involved in the inhibiting effect.

Table 6

Microdochium nivale	Average radial mycelium growth (mm)				Reduction in relation to the control			
Variant	Isolate Nor77	Isolate 386	Isolate Sick	Isolate Nor2	Isolate Nor77	Isolate 386	Isolate Sick	Isolate Nor2
Control = water	22.5	22.3	21.8	22.3	-	-	-	-
Derosal 10 ppm*	0.0	0.0	0.0	0.0	100%	100%	100%	100%
Derosal 100 ppm*	0.0	0.0	0.0	0.0	100%	100%	100%	100%
Folicur 10 ppm	0.0	3.2	0.0	5.6	100%	85%	100%	75%
Folicur 100 ppm	0.0	0.0	0.0	0.0	100%	100%	100%	100%
Magic Wet 10 ppm	20.8	21.0	21.5	22.0	7.5%	6%	1%	1%
Magic Wet 150 ppm	11.0	12.8	14.5	12.3	51%	43%	33%	45%

Microdochium nivale	Average radial mycelium growth (mm)		Reduction in relation to the control	
Variant	Isolate Nor77	Isolate Nor2	Isolate Nor77	Isolate Nor2
Control = water	24.3	26.5	-	-
Component 1 100 ppm	29.8	22.0	-	17%
Component 1 5000 ppm	12.5	11.8	48%	44%
Component 2 100 ppm	17.8	23.7	27%	10%
Component 2 5000 ppm	15.9	20.3	34%	23%
Component 3 10 ppm	21.3	22.3	12%	16%
Component 3 100 ppm	23.8	24.0	2%	9%

The invention is particularly significant in the case of isolates which have developed resistances to conventional fungicides, for example as illustrated here: two out of four *M. nivale* isolates (Table 6).

Pathogen: *Laetisaria fuciformis*

The mixture according to the invention is suitable for suppressing the pathogen responsible for red thread (*Laetisaria fuciformis*) during growth (Table 7). The effect emanates from the mixture as a whole because all three components tested are involved in the inhibiting effect.

Table 7

Laetisaria fuciformis Variant	Average radial mycelium growth (mm)	Reduction in relation to the control
Control = water	14.5	
Derosal 10 ppm	0.0	100%
Derosal 100 ppm*	0.0	100%
Folicur 10 ppm	0.0	100%
Folicur 100 ppm	0.0	100%
Magic Wet 150 ppm	8.5	41%
Control = water	47,0	-
Component 1 10 ppm	41.8	11%
Component 1 100 ppm	43.0	8%
Component 2 100 ppm	43.0	8%
Component 2 5000 ppm	32.5	31%
Component 3 100 ppm	43.3	8%

Pathogen: *Drechslera dictyiodes*

The mixture according to the invention is suitable for suppressing the pathogen responsible for leaf spot (*Drechslera dictyiodes*) during growth (Table 8). The fungicide Derosal* proved to be less effective than the mixture according to the invention.

Table 8

Drechslera dictyoides Variant	Average radial mycelium growth (mm)	Reduction in relation to the control
Control = water	19.5	
Derosal 10 ppm*	16.8	14%
Derosal 100 ppm*	14.3	27%
Folicur 10 ppm	0.0	100%
Folicur 100 ppm	0.0	100%
Magic Wet 10 ppm	19.3	1%
Magic Wet 100 ppm	12.0	38%

Pathogen: *Drechslera siccans*

The mixture according to the invention is suitable for suppressing the pathogen responsible for leaf spot (*Drechslera siccans*) during growth (Table 9). The fungicide Derosal* proved to be totally ineffective against this pathogen.

Table 9

Drechslera siccans Variant	Average radial mycelium growth (mm)	Reduction in relation to the control
Control = water	18.3	
Derosal 10 ppm*	19.8	-
Derosal 100 ppm*	20.0	-
Folicur 10 ppm	0.0	100%
Folicur 100 ppm	0.0	100%
Magic Wet 10 ppm	17.5	4%
Magic Wet 100 ppm	16.5	10%

Pathogen: ***Drechslera poae***

The mixture according to the invention is suitable for suppressing the pathogen responsible for lead spot (*Drechslera poae*) during growth (Table 10). The fungicide Derosal® was ineffective against this pathogen while the fungicide Folicur was only effective in high doses.

Table 10

Drechslera poae Variant	Average radial mycelium growth (mm)	Reduction in relation to the control
Control = water	6.5	-
Derosal 10 ppm*	6.5	-
Derosal 100 ppm*	6.2	5%
Folicur 10 ppm	6.2	5%
Folicur 100 ppm	0.0	100%
Magic Wet 10 ppm	6.5	-
Magic Wet 100 ppm	5.8	11%

As shown in the preceding Example, the mixture according to the invention supports the curative effect of fungicides (Derosal in the Example) and may be used in particular in those cases where resistance can be expected to be built up, as for example with *Drechslera*, *Pythium* or *Microdochium* species. Accordingly, the mixture according to the invention broadens the range of application of conventional fungicides.

CLAIMS

1. The use of aqueous preparations of

- fatty alcohols and/or partial esters of fatty acids with lower polyhydric alcohols in admixture with
- ecologically safe surfactant compounds from the class of alkyl (poly)glycosides of the o/w type (APG compounds)

as a plant-strengthening and/or plant-rehabilitating mixture (multicomponent mixture) effective against infestation of plants by phytopathogenic fungi and/or soil pesticides.

2. The use claimed in claim 1, characterized in that APG compounds based on at least substantially saturated C_{8-14} head-fractionated fatty alcohols are used, APG compounds at least predominantly containing $C_{8/10}$ fatty alcohols in the APG molecular structure being preferred.

3. The use claimed in claims 1 and 2, characterized in that alkyl oligoglucosides are used as the APG compounds.

4. The use claimed in claims 1 to 3, characterized in that fatty alcohols containing at least 6 to 8 carbon atoms in the molecule and preferably mono- and/or polyolefinically unsaturated fatty alcohols containing 10 to 28 carbon atoms and more particularly 12 to 24 carbon atoms are used in the multicomponent mixture.

5. The use claimed in claims 1 to 4, characterized in that fatty alcohols with solidification ranges of 20°C or lower and preferably 10 to 15°C or lower are used.

6. The use claimed in claims 1 to 5, characterized in that fatty acid partial esters of polyhydric alcohols containing 2 to 6 carbon atoms and preferably 3 to 5 carbon atoms, more especially glycerol partial esters, are used.

8. The use claimed in claims 1 to 6, characterized in that the fatty acid

partial esters are derived from C_{10-24} and more especially from C_{12-20} fatty acids, monoolefinically and/or polyolefinically unsaturated fatty acids again being preferred.

8. The use claimed in claims 1 to 7, characterized in that partial esters of glycerol with olefinically unsaturated $C_{16/18}$ monocarboxylic acids, more particularly glycerol monooleate, are used.

9. The use claimed in claims 1 to 8, characterized in that the fatty alcohols and the partial esters and preferably the APG compounds also are based on natural materials.

10. The use claimed in claims 1 to 9, characterized in that the fatty alcohols and the fatty acid partial esters are used in mixing ratios (parts by weight of the water-free components) of 1:1 to 1:10, preferably 1:1 to 1:5 and more preferably 1:1 to 1:3.

11. The use claimed in claims 1 to 10, characterized in that the APG components are used in at least substantially equal quantities by weight, based on fatty alcohols and/or partial esters, mixing ratios of APG:fatty alcohol and/or partial ester of 1:1 to 5:1, preferably 1:1 to 3:1 and more preferably 1.5 to 2.5:1 – parts by weight, based on water-free mixture components – being preferred.

12. The use claimed in claims 1 to 11, characterized in that lower polyhydric alcohols preferably containing 2 to 6 carbon atoms and more preferably 2 to 4 carbon atoms, more particularly glycerol and/or glycol, have been added to the multicomponent mixtures.

13. The use claimed in claims 1 to 12, characterized in that dilute aqueous preparations which have been obtained from flowable concentrates of the multicomponent mixtures containing lower monohydric alcohols preferably containing 1 to 4 carbon atoms, more particularly ethanol, as additional viscosity regulators are used.

14. The use claimed in claims 1 to 13, characterized in that, besides or instead of the fatty alcohols, the multicomponent mixtures contain terpene

alcohols as mixture component(s)

15. The use claimed in claims 1 to 14, characterized in that the multicomponent mixtures are applied, preferably by fine spraying in the form of aqueous emulsions/dispersions, in quantities of 0.5 to 35 g/m², preferably in quantities of 1 to 20 g/m² and more preferably in quantities of up to 15 g/m², based on water-free mixture.

16. The use claimed in claims 1 to 15, characterized in that water-diluted mixtures in which the ratio by weight of the multicomponent mixture to water is at least 1:10 and preferably at least 1:15 to 20 are used.

17. The use claimed in claims 1 to 17, characterized in that the multicomponent mixtures are used in commercial plant production, in landscaping and in commercial or domestic horticulture.